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Challenges With Managing Projects In Third World Countries

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Challenges With Managing Projects In Third World Countries

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Report

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Dedication

This report is dedicated to my parents for their endless support and guidance.

Acknowledgements

I would first like to thank my thesis advisor Dr. James O'Connor of the Civil Engineering Department at The University of Texas at Austin. Dr. O'Connor always steered me in the right the direction whenever he thought I needed it and his guidance played a very significant role in shaping this report.

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I would also like to thank the Fellgroup for giving me the opportunity to gain valuable experience of managing construction projects in some of the most remote locations in the world. The experience provided me with the insights about the issues affecting construction projects in these locations, which became the basis for this report.

Finally, I must express my very profound gratitude to my parents and my sister for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this report. This accomplishment would not have been possible without them. Thank you.

Vaibhav Bhatia

Abstract

Challenges with Managing Projects in Third World Countries

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The University of Texas at Austin, 2016

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Recently, there has been a focus on development of some of the most underdeveloped countries, six of the world's ten fastest growing economies of the past decade are in sub-Saharan Africa [1]. As a result, lot of new construction projects opportunities have come up in some of the most remote locations of the world. Construction projects in these regions face a multitude of problems which stem from basic sociopolitical difficulties these undeveloped countries have been facing for the past few decades. This report aims at highlighting some of the major challenges associated with execution of these construction projects. The report also analyzes some of the root causes behind these challenges and provides some recommendation that might prove effective in managing these challenges.

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Introduction

Background & Need

In [2], the author makes a point for construction to be considered as a complex dynamic phenomenon and in my opinion the complexity of the construction process is greatly influenced by the location of the project. On time delivery of a civil engineer projects and ensuring quality work is a very challenging task, primarily because we tend to underestimate the complexity of the tasks and overestimate our capabilities. Construction industry in third world countries is not as organized as it is in the developed countries, it is plagued by many issues that arise from the sociopolitical instability in these countries. All these organizational and sociopolitical issues lead to a subpar performance in construction projects [3], [4] and hence arises the need to study these issues and their impact on the construction projects.

Scope Limitation

This study is primarily based on my own experience of working on three different projects in Africa during my summer internship in 2015. As I was not involved in any industrial type projects most of the data for the study is taken from commercial/residential building and infrastructure projects, the analysis is mainly relevant to those kind of problems although some broader issues discussed in the report like proper planning, ensuring safety and communication hurdles are pertinent to all kinds of construction projects as they are not specific to the size of project. The study is based on small to medium sized projects and has very little relevance to mega construction projects. Also, due to the lack of research in the countries where the projects are located most of the literature referred is from other countries where similar problems exist.

Purpose and Objective

This report is aimed at discussing some of the major causes that in my opinion make construction a very challenging task in third world countries and the issues faced specifically when managing these projects from remote locations. This report will also include recommendations based on literature review and my own experience to tackle some of these issues.

In my opinion some of the major issue faced by construction industry are as following:

1. Unavailability of reliable data
2. Unavailability of competent subcontractors
3. Unavailability of resources
4. Lack of financing options
5. Lack of safe work environment
6. Lack of proper communication systems.

Research Methodology

These report is based on the information from the projects I worked on during my summer internship in 2015. Most of the quantitative data used is from projects in Africa currently in construction or in conceptual planning stage. During my internship I worked on projects in three different countries (Niger, Mauritania and Kenya) and bid planning for projects four more countries in Africa. This report is a direct application for my learnings during my internship. To get an in-depth understanding of some issues I reviewed technical and research papers which related to scope of this study. It is very hard to find substantial technical research for the countries which my projects were related so I relied on research based on projects in Nigeria, Indonesia and Malaysia that discussed issues similar to the ones we were facing in our projects. I also used a tool [5] to check the validity of bid prices and estimated duration of building construction projects for analysis of subcontractor's bids. The tool was only used for comparative study as I was not certain about its overall applicability in the context of our projects as the tool was developed for infrastructure projects in UK. The results obtained from using the tool are used to compare the project durations quoted by subcontractors in the case study on bidding process for a construction project in Somalia.

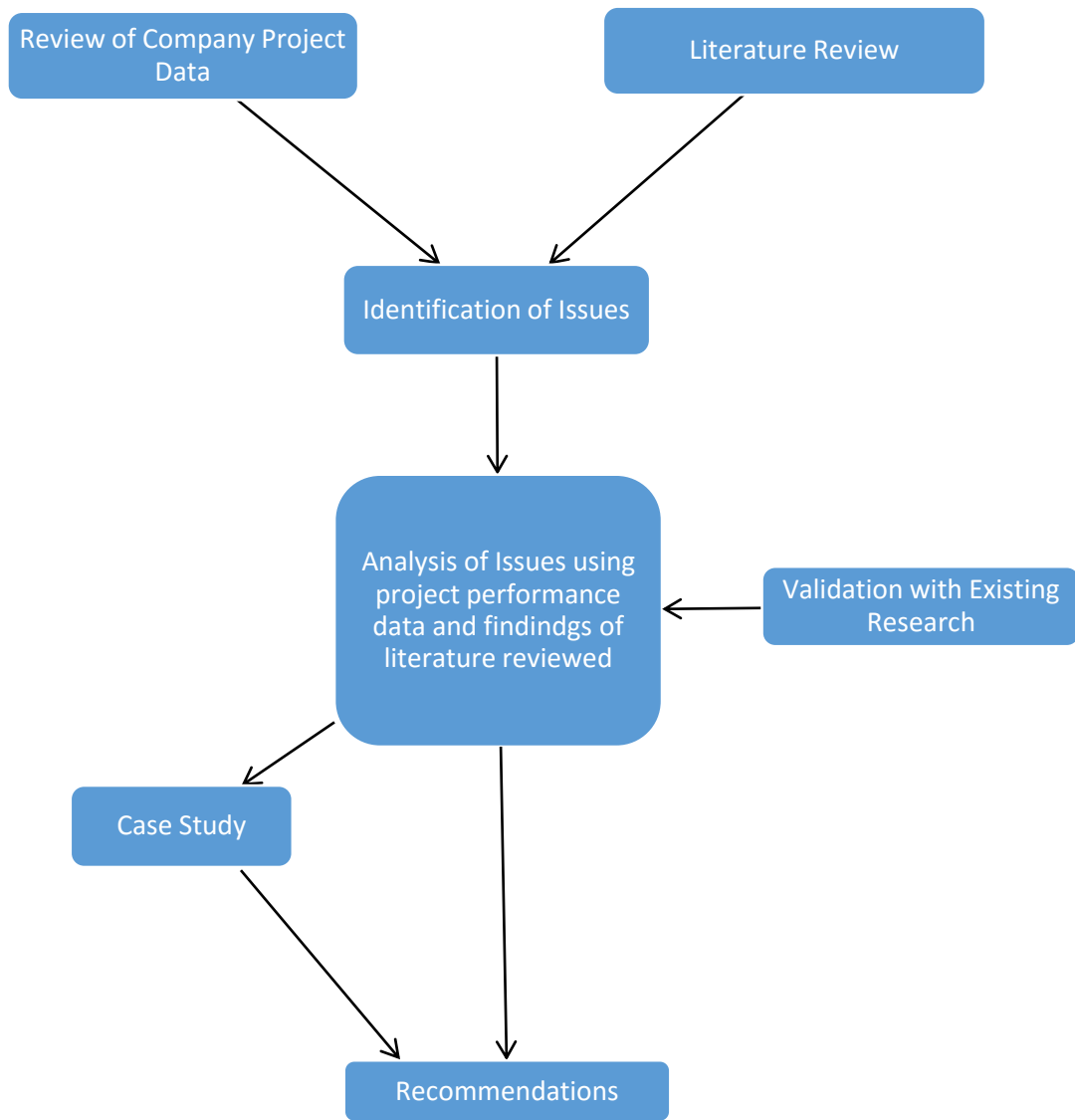


Figure 1: Flow Chart for Research Methodology

Structure of the Report

This report starts by identifying the major issues and then explains how these issues adversely impact the performance of construction projects. The report also includes a case study on bidding process for a construction project in Somalia to illustrate the impact of some of the issues faced

during the bidding process and discuss some measures taken to reduce their impact. The report also analyzes some of the issues affecting construction performance identified in the report and their impact and provides recommendations on how to mitigate the negative impact of some of these issues in the end along with concluding remarks.

Literature Review

Several articles on performance of construction projects in developing and underdeveloped countries were reviewed. Some of the major sources are:

In *Construction as a Complex System*, S Bertelsen, the author discusses how construction should be treated as a complex dynamic system. The study encourages us think of construction as not a simple linear process and analyze its different components and relationships for better project management.

In *Modelling global risk factors affecting construction cost performance*, Daniel Baloi & Andrew D.F. Price, analyzes risk factors impacting the schedule and cost performance of a project. The study supports the argument that sociopolitical environment of a country has an influence on the performance of construction projects.

Factors affecting cost performance: evidence from Indian construction projects, K.C. Iyer, K.N Jha, presents the findings of a questionnaire survey on factors affecting cost performance of construction projects. The paper highlights the fluence of socipolitical environment among other factors on cost performance of projects.

Factors influencing construction time and cost overruns on high-rise projects in Indonesia, Kaming, P. F., Olomolaiye, P. O., Holt, G. D., & Harris, F. C. (2010), was studied to get a better understanding of the issues that lead to poor performance of construction projects and analyze their importance and impact in the scope of this study. The study discusses the major causes of delay and also analyzes the relationships between delay and cost overrun variables.

Predicting Construction Duration of Building Projects, Martin, J., Burrows, T. K., & Pegg, I. (2006), discusses a metric that corelates the duration and estimated cost of building type projects in UK.

The metric was helpful in performing a comparative study for bid quotes by subcontractors based on the quoted construction costs and project durations.

Time and Cost Performance in Construction Projects in Southern and Central Regions of Peninsular Malaysia, Memon, A. H., Rahman, I. A., & Azis, A. A. (2012), provides information about performance of construction projects in Malaysia. It provides real world data on the cost and time overruns on projects in Malaysia. Although Malaysia is much more developed and cannot be considered a third world country, this study provides us with information which can be expanded to project performance in underdeveloped countries. The study was used to analyze the performance of construction projects and attain information about fraction of projects completed in time and within budget.

Problem's Influencing Craftmen's Productivity in Nigeria, Olomolaiye, P., Wahab, K., & Price, A. (1987), provides comprehensive information about the factors influencing the productivity of labor. The paper provides a ranks these factors, e.g., lack material, lack of proper tools, poor supervision, on the basis of their overall impact on productivity. The study provides us an insight about some of the root causes for poor project performance in underdeveloped countries.

Handbooks in Operations Research and Management Sciences: Transportation, M. Christiansen, K. Fagerholt, B. Nygreen and D. Ronen, discusses the operational research developments in transportation. The study also supports the argument made in this report about the uncertainty of maritime transportation.

In *Understanding the key risks in construction projects in China*, Patrick X.W. Zou, Guomin Zhang & Jiayuan Wang, the authors study key risks for construction projects and try to come up with strategies to manage these risks. The paper lists lengthy bureaucratic and administrative procedures as one of the key risk factors for both cost and schedule performance.

Critical Path Methods in Construction Projects, J.M.Antill, & Woodhead, R. (1990), was also reviewed to get a better understanding about construction delays and their causes.

Finance in Africa : Achievements and Challenges, Thorsten Beck, Michael Fuchs and Marilou Uy (2009), discusses the current state of financial market in Africa and its future. It talks about the

systematics changes that might help improve the current state of affairs and also discusses how global financial turmoil has an impact on the growth of African economy.

Economic Development Through Bureaucratic Corruption, N H LEFF, provides a early viewpoint of Buerocratic corruption. It discusses how buerocratic corruption forces government to be more involved in the development process and creates a cometetive environment which in turns boosts progress.

Corruption Around the World: Causes, Consequences, Scope, and Cures, Vio Tanzi, provides a counter argument to the earlier held belief of the postive impact of Buerocratic Corruption on growth. It discusses the causes and impact of corruption and also provides measures to check corruption.

CII Study: SD-105 – Analysis of Pre-Project Planning Effort and Success Variables for Capital Facility Projects, discusses the importance of pre-project planning for project successes. The study identifies preproject planning variables which are which, stistically, lead to project success. The study also develops a regression model to study the corelation between preproject planning effort and project succcess. When project enters construction, the amount of control we have on setting the course of the project reduces significantly, the contol significantly lower in countries underdeveloped countries like Niger, Somalia etc. where procuring and delivering simple piping fixtures may require you to hire truck which will travel overnight and the transport itself will end up costing more than the material.

An empirical analysis of the relationship between project planning and project success, D. Dvir, Tzvi Raz and Aaron Shenhar, analyzes the importance of project planning for project successes. In reference to this report the stuy helps us examine the importance of clearly understanding the scope requirements and how scope creep can be extremely detrimental to project performance.

Competence and timing dilemma in construction planning, R. Tucker and A. Laufer, analyzes assignment of roles and responsibilities for project planning and proposes a new approach for project planning. The study is used assert the importance scope definition for clear understanding of project requirements which directly influences project performance.

Project Definition Ratings Index, CII, is front end planning tool which helps evaluating the level of scope definition. PDRI can be used to great advantage in projects anywhere to prevent scope creep. Using PDRI for construction projects in third world countries can be effective in early identification and management of uncertainties.

A study of pre project planning and project success using ANNs and regression models, Y.R. Wang and G. E. G. Jr., examines the relationship between pre project planning and project success using regression analysis and artificial neural networks. The study is used again assert the importance of pre project planning.

A systematic approach for monitoring and evaluating, Z. A. Memon, M. Z. A. Majid and M. Mustaffar, discusses how new technologies can be used to evaluate construction progress site. These technologies can be extremely important in progress evaluation and monitoring in third world countries where we lack experienced personnel to progress evaluation.

Risk analysis and management in construction, A. S. Akintoye and M. J. MacLeod, discusses the importance of risk management for construction projects and the lack of use of formal risk assessment techniques in construction industry. The points discussed in the study provide guide on how to better manage the risk associated with construction projects and can positive impact on the performance of projects in third world countries.

CII's International Project Risk Assessment (IPRA) Tool can be instrumental in assessing risks associated with international construction projects. The tool is very comprehensive and considers 82 different risk elements. The tool can be extremely effective during the bidding and pre-project planning stage of a project.

Design Rules: The Power of Modularity, C. Baldwin and K. Clark, examines the importance of modularization. They use success of modularization in computer industry and propose that the same success can be implemented in other sectors. In third world countries where maintaining safety & quality is a challenging task coupled by the low of skilled workforce, modularization can be an effective solution

Further, more studies were referred to come up with pertinent recommendations to overcome these challenges.

Issues, Concerns & Consequences

Some of the issues facing the construction industry can be resolved by proper planning and doing the due diligence but most of these issues are a result of deep-rooted social, political and economic problems in these countries which require systematic changes and are hard to work through. The above mentioned issues and their impact on construction is discussed in detail in the following section.

1. Unavailability of Reliable Data

For successful execution of any project, it is very crucial to have prior knowledge of certain parameters like, climatic conditions, transportation infrastructure, soil conditions, material availability and costs, labor availability, prevalent construction techniques in the region, so that we can plan for any eventualities. The amount of data we have and its degree of reliability has a huge impact on the performance of project based on set plan. Proper collection and management of this geotechnical data, hydrological data, topographical data, weather data, material availability, material and equipment cost, labor data has been made possible by the advancement in technology that has taken place in the recent past. Due to the lack of availability of these technologies and to some extent that lack of need of such data up till now in these areas, there are no reliable sources from which we can attain the data required for proper planning of construction projects. Following are the examples of some of the data required and how their unavailability effects the construction.

i. Limited geographical data:

As these countries have not seen a lot of construction projects, there are no resources or organizations from where you could get even the basic geographical data like maximum recorded rainfall, water table, bedrock characteristics etc. For execution on any project, thorough soil tests are required to be performed to obtain characteristics of the soil and samples are usually sent to major cities of those countries or some other countries to get reliable results. All this work is extensively time consuming and requires significant expenditure. Necessary data like, seismic, annual expected

rainfall, maximum 100 year rainfall etc. which are necessary for design purposes are very hard to find and most of the times design has to be done based on a lot of assumptions.

ii. [Limited cost information:](#)

Due to the uncertainty about the availability of resources, the information about material cost becomes very hard to get. Also, because to the lack of advancements in communication systems it is very hard to get in touch with local vendors which makes accurate estimating for projects a very difficult task. The only reference that we have is from the bid estimate of subcontractors and that also varies a great deal from one subcontractor to another. For the same job the variation in quotes from different subcontractor may be up to 75 %. This makes bidding for this projects really risky as you have no idea about the accuracy of the prices.

iii. [Limited information about construction methods and techniques:](#)

Most of the times during bidding process a preliminary schedule is required to be submitted along with the proposals. Most of these countries have not yet seen significant technological advancements and old construction methods still used, e.g., in one of the projects I worked on a manually operated derrick crane was used for all the heavy lifting, the concrete compaction was done using tamping rods instead of vibrators, excavation was done manually using hand tools. Also, due to limitation with transportation system, most of the fabrication is preferred to be done on site. Concrete is carried manually to heights for pouring as the lifts and boom placers are not available in these regions. Creating a schedule and estimation labor costs becomes really hard because it is not very simple to calculate the productivity of those methods and their dependence on external factors.



Manually Operated Derrick cranes being used to erect structural steel members

**Source: Company Data from Summer Internship*

2. Unavailability of Competent Subcontractors

Due to the kind of capital required to execute civil engineering works and economic condition of these countries, not a lot of competent subcontractors are available to execute the work. Even for a small residential construction job, sometimes the subcontractors have to be hired from foreign countries and generally a single contractor does all the work be it concrete, steel, electrical or mechanical works which detrimentally effects the quality and schedule of the work.

i. Inexperienced Personnel:

As most of these companies have been confined to their particular domains and have not had a lot of construction work in the past due to the country's political environment, their employees lack quality construction experience. Sometimes do meet the demand of the project they hire people who have never worked in construction before. This all leads to an unorganized construction team which cannot be relied upon for successful execution of work.

ii. **Lack of Competition:**

One other problem that arises from this is lack of reasonable pricing, as there is virtually no competition to the one or two subcontractors. They most of the times quote prices which are unreasonable and without lack of sufficient information about the local environment it is extremely hard to determine the accuracy of quoted prices.

iii. **Ill-Equipped and Poorly Structured:**

Most of these subcontractors have either been out of work for a long period of time or have recently set up their companies, so they lack the minimum basic equipment like survey equipment, dumper trucks, excavators etc., required to execute a construction job. They seldom have any modern equipment, like total station, boom placer, transit mixers, etc. and use primitive methods to execute the works. Even if new equipment are procured for the projects, intensive training is also required to be provided for subcontractor personnel for the proper use of equipment, which generally has huge time and cost implications.

iv. **Lack of Professional Attitude (Not Concerned about Quality and Safety):**

Most of these subcontractors do not give preference to ensuring quality and safety while execution of works. Their methods are outdated; e.g., concrete is still carried manually to heights instead of using a boom placer or a lift. They do not have any quality or safety personnel in their team and tend to skirt away from safety and quality guidelines. To onus of ensuring quality and safety falls entirely on the general contractor.

3. **Unavailability of Resources**

For smooth execution of any construction job availability of resources is must. Any break in the flow of resources to the site leads to delays in the construction which leads to financial implications. Various factors related to resource unavailability and their consequences are discussed below.

i. **Lack of Basic Amenities:**

Most of these countries do not have proper infrastructure for even the basic amenities like potable water, sewage system, etc. To provide these amenities to workers on site becomes a matter of huge expenditures. Water tankers or packaged water is not available on remote locations and sometimes digging a bore well close to construction area becomes a necessity. Also due to lack of sewage, depending on the magnitude of project, it might be required to build a septic tank for the workers on site. The availability of electricity on construction site is also a major issue, most of the times electricity requirement is met using generators which have to be rented or purchased from major cities and then transported to the site and require a permanent maintenance personnel to fix any issues with it.

ii. **Lack of Construction Equipment:**

The construction industry has not progressed a lot in these countries and they rely on manual labor for most of the work. Equipment like tower cranes, boom placers, etc. that significantly reduce the manual labor and are very easily available in developed world are nowhere to be found in these countries. Concrete mixing is done by hand tools or by mechanical mixer. The mix proportioning is also done by hand. Batching plants and transit mixers are not readily available. In most of the places the excavation is also done by manual labor using hand tools, which is highly time consuming. Tower cranes and truck cranes are seldom available. For erection of steel structural members mechanical tower cranes are used. This extensive dependence on manual labor makes the jobsite very unsafe to work and also makes the development of a realistic schedule extremely hard.

iii. **Lack of Financial Resources:**

These countries do not have sound financial institutions which can be used to obtain finance for the projects, which requires subcontractors to either invest their own

money or to get loans from international financial organizations that charge hefty interest rates. The process of arranging these finances also takes a lot of time. The application and approval of minor loans can take somewhere from 3 to 5 weeks. Although, the financial infrastructure in some of these regions is improving, it still has a long way to go in order to support big industries like construction [6].

iv. **Unavailability of construction materials:**

Most of the times the construction material like concrete, rebar, structural steel, bitumen etc. have to be procured from other countries which requires their procurement to begin very early in the project lifecycle to meet schedule deadlines, resulting in inaccurate quantities. The material procured from other countries are also prone to damage and losses during transportation.

v. **Poor transportation infrastructure:**

Logistics is a huge problem in these countries. Due to lack of availability of material and equipment locally, they have to procure from other countries. This leaves a huge uncertainty in the schedule of works. Most of the equipment are procured from countries like China, South Korea and Japan and are shipped via sea routes. Due to the unpredictable nature of maritime industry, these equipment often arrive late at the destination ports. If the construction site is in a landlocked country, dealing with customs in different countries can cause a lot of delays and money. The road networks in these countries are also not very well constructed. Then, the equipment is more often than not damaged in the road journey from the port to the site. Even though the insurance of the equipment might minimize the financial losses, the time taken to fix the equipment is direct delay in the schedule of project.

vi. **Lack of workforce familiar with modern construction techniques:**

Most the people working in construction in these places have been working with the same methods as were used 50 years ago. They have no knowledge or experience of the new ways of constructing a structure. As houses made out of concrete and steel are not still very popular in remote regions, there are not a lot of construction labor which has experience of working with concrete and steel structures. Equipment operators are very hard to find, because most of the work is done physically. So, it is a necessity to either train people on site or get skilled labor from other countries.

vii. **Unavailability of Safe Storage:**

Storing Material on the construction site is not a smart option in these areas. You need armed guards, chain link fencing and sturdy structures for secured storage on sites. As this would require a huge investment, the material is procured just in time for the construction work to take place which leaves no scope for any sort of buffer, so any delay in delivery of materials is a direct delay to the project completion. The material that is stored on site often gets damaged by external environmental conditions due to lack of proper infrastructure, this has a hugely negative impact on the quality of final product.

viii. **Lack of Basic CAD Technology:**

In the developed countries use of modern CAD tools to support construction is becoming very popular. For construction planning 4D Cad is being used, 3D models and Point clouds are being used for progress monitoring. But in the underdeveloped countries even availability of a computer or a printer at site is very rare. Most of the times the correspondence is through regional headquarters and any revision in a drawing takes somewhere close to one week to be communicated to site.

Unavailability or lack of availability of the resources discussed above negatively affect productivity of construction. Projects which can easily be completed in four months

in any developed countries, take close to a year to complete in these regions. Labor productivity is close to two thirds, this is based on the comparison of actual time taken to finish the task an expected duration for the same task in US

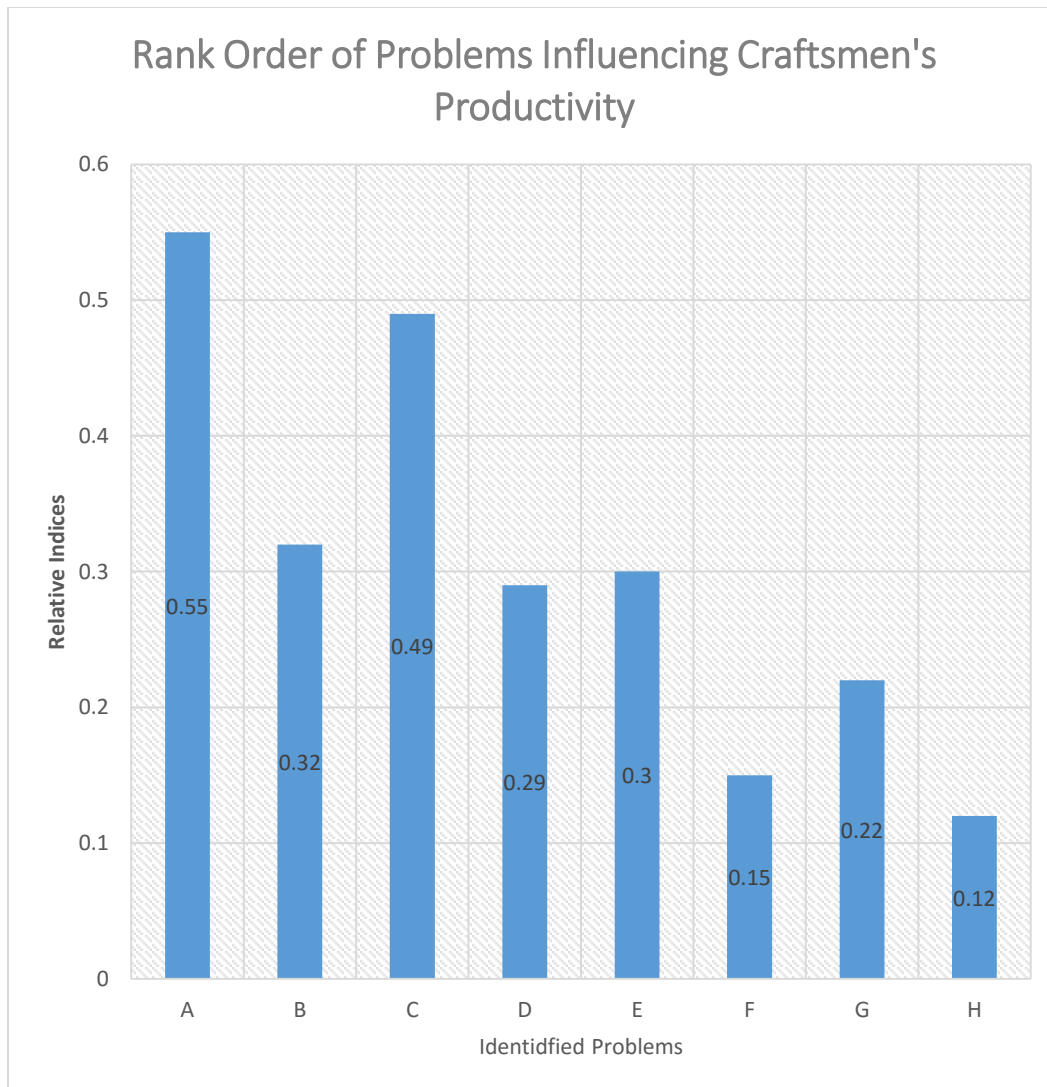
The following information has been taken from [7]

Time Utilization in the key trades expressed as a percentage of attendance time								
		Percentage of attendance time per site						
Trades/ Activities	Mean	A	B	C	D	E	F	G
Joinery								
Working	44	52	61	37	46	38	43	29
Idle	37	33	23	39	31	47	29	54
Taking Instructions	13	7	11	13	21	9	19	13
Waiting	6	8	5	11	2	6	9	4
Bricklaying								
Working	51	53	72	50	22	56	54	48
Idle	27	24	14	35	39	27	28	20
Taking Instructions	6	6	8	6	9	4	6	4
Waiting	13	17	6	9	3	13	12	28
Steel Fixing								
Working	56	67	74	64	65	21	47	51
Idle	36	22	16	32	34	71	41	34
Taking Instructions	5	8	6	3	1	7	4	4
Waiting	3	3	1	1	0	1	8	9
These are activity sampling results at 95% confidence level. Two typical craftsmen were chosen in each trade for the observations with slight differences in the task performed from site to site.								

Table 1: Time utilization in key trades expressed as a percentage of attendance time

Source: "Problems Influencing Craftsmen's productivity in Nigeria" [7]

The table above shows distribution of worker's time on site. It can be seen that almost 42 % of the total working time on site is wasted. These wastages can be attributed to several factors such as work conditions, material availability, labor's expertise, etc. In [7], authors developed a rank order matrix for the problems influencing workers productivity in Nigeria.



A	Lack of Materials
B	Lack of Proper Tools
C	Repeat Work
D	Instruction Delays
E	Inspection Delays
F	Absenteeism
G	Supervisor's Incompetence
H	Changing Crew Members

Figure 2: Rank order of problems influencing craftsmen's productivity

Source: "Problems Influencing Craftsmen's productivity in Nigeria" [7]

From their analysis in [7], authors found that the most critical problems influencing the worker's productivity were lack of material, lack of proper tools and repeat work.

Percentile rank of the sources of craftsmen's productivity problems								
		Ranking Result Per Site (%)						
Sources of Problem	Mean	A	B	C	D	E	F	G
Lack of materials								
Caused by transports difficulties	27	32	34	18	35	25	21	23
Excess paperwork before requisition	9	4	32	0	0	12	0	15
Outright shortage	27	20	0	36	21	25	50	38
Receipt of improper material	11	24	32	9	14	0	0	0
Lack of proper planning	25	20	0	36	29	38	29	23
Lack of proper tools								
Poor quality tools	15	27	0	20	0	32	14	11
Improper maintenance	44	36	0	58	71	34	64	44
Outright shortage	26	36	0	20	29	34	21	44
Repeat work								
Poor instructions	41	60	25	57	34	34	43	36
Misinterpretation of drawings	16	0	0	7	34	20	21	29
Design changes	43	40	75	36	32	46	36	36

Table 2 : Percentile ranks of the sources of craftsmen's productivity problems

Source: "Problems Influencing Craftsmen's productivity in Nigeria" [7]

A further investigation was done to find the root causes for these problems. The above figure provides information about the base causes of the problems. The results of further investigations indicated that the major contributing factors to material unavailability were:

- **Transportation difficulties:** As discussed above the transportation infrastructure in underdeveloped countries is not in a very well-constructed. This has a big impact on the performance of projects as transportation of equipment, material and labor remain a huge challenge due to lack of local availability.
- **Material shortage:** This can be attributed to poor pre-project planning and impacts both the project cost and duration
- **Lack of proper planning:** This is the root cause of most of the issues other contractor's control and it can also be attributed to lack of reliable data and experienced personnel.

The major contributing factors for equipment unavailability were:

- Improper maintenance: Due to lack of skilled workforce locally discussed above, maintenance personnel has to be called from major city centers, which increases the maintenance costs and negatively impacts routine maintenance.
- Equipment shortage: As discussed above equipment availability is limited in underdeveloped regions. This can be attributed to many factors like economic conditions, lack of development projects in the past, etc.

The major contributing factors for repeat work were:

- Design: This can be attributed to the lack of reliable data available prior to design discussed above.
- Poor instructions: This is direct consequence of lack of construction knowledge and experience discussed above.

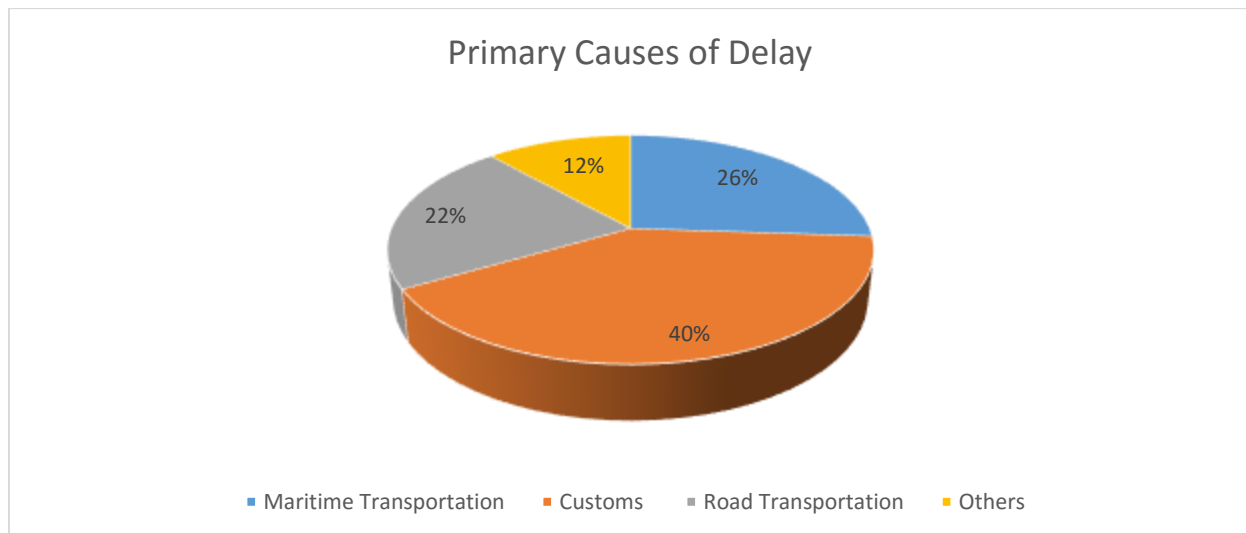


Figure 3: Delay Statistics of a horizontal construction Project in Africa

**Source: Company Data from Summer Internship*

The figure above shows the primary causes of schedule over run in one particular project. The project required some specific equipment like, aggregate crusher, bitumen plant, bitumen sprayer, paver, etc. which were not available locally and had to be imported from China and Europe. The shipping of the equipment took longer time than expected. In [8], the author claims that there is much more uncertainty in maritime industry than other

forms of transportation which can be attributed as the reason for delays in shipping industry, as experienced by us. After their arrival at port, the equipment were stuck in customs and it took close to a month to get their custom clearance. All the equipment were cleared by customs at once and we did not have enough trucks to transport all the equipment to site at once, So the trucks had to go back and forth several times to bring the equipment at site. This all resulted in a two month delay on a 12 month job.

4. Lack of financial infrastructure:

Most of the subcontractor costs are revenue financed as there are very limited resources for getting a loan. This becomes a huge problem because sometimes due to lack of capital the work is halted till a payment is received from the client for performed work to procure the required material and labor for upcoming tasks. Because of their impact on our projects the following, in my opinion, are the three most important issues that arise out of lack of financial infrastructure in a country:

i. Limited Financial Institutions

Some of these underdeveloped countries like, Somalia, Niger, etc., have very few financial institutions and most of them operate at a local level with very limited financial capability. It is very difficult to finance a construction project from these local financial organizations. Some global financial institutions that operate remotely in some of these regions are the only credible source of financial services. Some of the times all the financial activities are done through a neighboring country which has relatively stable financial infrastructure. This means that there is a lag between any financial activity and the construction activity.

ii. Credibility of Financial Institutions

As the financial institutions discussed above operate at a local level and have no backing from any credible financial source, their letter of guarantees are generally deemed invalid by international institutions. So, even for getting a performance guarantee the subcontractors have to have to use foreign financial institutions.

iii. **Difficulty in Money Transfer**

Paying money to subcontractors becomes a very cumbersome task. In most of these underdeveloped countries very few money transfer services operate and most of these are unreliable local institutions which charge up to 30% of the transferred amount.

5. **Lack of Safe Industry Culture:**

Construction Safety is not given a lot of emphasis in third world countries. An International Labor organization survey found out that 16.5 % of construction workers in India suffer injuries while at work¹. If India, which is a developing country and has a regulatory system for workplace safety, has such an abysmal record, the conditions in the third world countries could not be better. Most of these can be attributed to the following factors:

i. **Lack of Safety Guidelines**

Most of the underdeveloped countries do not have strict guidelines regarding safety for the contractors and subcontractors. In absence of these regulatory guidelines the contractors never give any consideration to improving the safety at construction site and the work is executed using extremely unsafe activities.

ii. **Lack of Safety Planning**

Very few contractors have their own safety plans and most of them are never implemented. Very few contractors provide safety training to their workers and based on my experience there seldom is a safety officer present on site. There is no safety analysis before executing a task. For our projects in East and West Africa we had to send our own Safety Plans and Procedures for the site team to adhere to. After our repeated insistence to our partner on site, a Safety officer was commissioned at site and a daily safety log was maintained at site.

¹ Source: <http://scroll.in/article/656863/as-indians-criticise-qatar-construction-deaths-a-sad-fact-india-ranks-no-1-in-construction-worker-deaths>

iii. **Lack of Safety Gear/ Equipment**

A lot of the times there is no safety gear available for workers. There is so little priority given to safety that in progress pictures received from site we could see labor doing the excavation work barefoot, people working at heights without full body harnesses and workers working without high visibility jackets at night. For our projects we had to send our own Safety Plans and Procedures for the site team to adhere to. After our repeated insistence a Safety officer was commissioned at site and a daily safety log was maintained at site.

iv. **Lack of background Checks:**

There is little to no provision of doing background checks before hiring labor for construction jobs in underdeveloped countries due to unavailability of any database or labor records. For skilled labor there sometimes is a background check but for hiring unskilled labor there seldom is any criteria to determine their suitability for the task. This leads to hiring of untrained and inexperienced labor which leads to high rate of accidents [9].

6. **Unreliable Communication Infrastructure**

Proper communications play a very important role in successful management of construction projects. It is very important for cogent decision making at management level. The uniform flow of information from site to office and vice versa facilitates the successful execution of work [10]. From my experience, the communication from site can be divided into following six major categories:

- a) Progress: This generally pertains to information regarding the progress of activities on site. It is very important for schedule tracking and invoicing.
- b) Request for Information: This is generally a request for clarity on any issue pertaining to construction which require remediation from office.
- c) Alert: It can be any information that needs immediate attention. It can be anything from a hostile weather condition to material shortage.

- d) Safety: It pertains to any safety related information that has to be transmitted from or to a site. It can be information about lack of safety equipment or a safety incident.
- e) Quality Control: It pertains to transmitting information related to concerns of the quality of the execution of work at site.
- f) Inventory: This kind of information is important for documentation of work at site. It consists of different reports, bills etc.

There are many barriers to accurate transmission of information ranging from inexperienced personnel to subjectivity of progress interpretation but, in my opinion, the three most crucial which are specific to these regions are as following:

i. [Language Barrier:](#)

In my experience communicating with personnel on site is really hard as, generally, there are only two or three people in the upper management of subcontractor firm who can communicate in English. So they become the primary source of reporting from site. If they are not available, getting relevant information becomes really hard because of lack of personnel with knowledge of local language on our side. Also, it means that you are getting second hand information (information which is not coming directly from the source but is interpreted by someone along the way) which increases the chances of miscommunication.

ii. [Poor Communications infrastructure:](#)

Internet connectivity in these places is not very good. Most of the times the site engineer has to travel to their headquarters in major cities to send the required progress information and pictures, which means that frequency of progress reporting is reduced. This makes managing these projects difficult.

iii. [Intentional misreporting by subcontractor:](#)

It is not possible to directly oversee the construction as sending personnel to these regions and supporting their day to day costs is very expensive because of the

remoteness of the location of work, the contractor is dependent on subcontractor for progress monitoring and reporting. Most of the times to increase the inflow of cash or to avoid any penalties, from my experience, the subcontractor occasionally misreports crucial information like construction progress and Quality & Safety compliance, which makes managing these projects a really hard task.

Other Concerns

Apart from the issues discussed above the following concerns are also of huge significance:

1. Challenges with Lump sum Turn Key (LSTK) Delivery

In my experience, most of the clients in these regions prefer LSTK contracts as it binds the contractor to fixed price and a fixed date of completion for the defined scope. This might be attributed to the difficulties involved with project execution and the inherent risks of schedule and cost overruns which become contractor's burden. This makes bidding on these jobs a very difficult task for the contractor because of the uncertainties involved. If he takes into account all the risks and properly plans the contingency he might end up with a very high costs which will diminish his chances of winning the project. If he does not plan for contingency he might end up losing a lot of money. So generally to successfully bid for these projects one has to make compromise between the best and the worst possible situations. One other way to reduce the risk is to not bid on these projects alone but with one or more Joint Venture (JV) partners, which leads to distribution of risk among the partners and you can be more aggressive with your pricing.

Working in JVs has its own drawbacks. As you are not the only one in charge you do not exercise complete control over the decision making. So at every crucial step you need the approval of all the partners which sometimes slows the decision making process. One other problem that arises is that you are equally responsible and liable to any mistake or shortcomings caused by a JV partner.

The LSTK projects generally have a fixed time frame and significant liquidated damages for delay. So the work has to be started as soon as the job is awarded. But the biggest problem is that there is very limited data available (data on site characteristics, resource availability, etc.) and if the work is started right away based on the limited data we have we might have a lot of rework in the future. So instead most of the times thorough site investigations are done after the award of the contract to get necessary data. This might have financial and cost investments but significantly reduces the possibility of rework.

Finally, the work presents new challenges at different stages, due to inadequate data available beforehand, the real information is received when the work actually starts. Changing the plan after mobilization is extremely expensive as it might require new resources, which might cause additional logistics costs and a delay which also has additional life support costs associated with it. Sometimes the client might approve a change order but most of the time the contractor ends up with an unsettled claim. The time spent sorting out the issues with labor and equipment mobilized at site becomes a direct cost to contractor.

2. Corruption & Bureaucracy

A lot of times the construction progress is halted because of the lengthy bureaucratic procedures and corruption in government agencies. In [11], author lists bureaucratic procedures as risks to both cost and schedule performance. The initial attitude towards corruption in underdeveloped countries was that corruption promotes economic growth by enhancing investment because of removal government imposed rigidity [12], but author in [13] argues that corruption actually leads to a reduction in investment and much less efficient economic system to promote growth.

This problem starts as soon as the bidding stage. To bid for projects in these countries a basic requirement for contractors is registration with local authorities. The process varies from region to region and is extremely complex. Bidding usually takes three to six months to get registered with the local authorities.

The second major obstacle caused by bureaucratic procedures is while obtaining the required permits to begin a job. Permits are often required for waste disposal, road closure, power supply, water supply, etc. After award of the job, in my experience, it requires close to one or two months of efforts by two to three fulltime employees to get these permits. The procedural cost of obtaining these permits ends up being much higher than their actual cost.

The third major way the bureaucracy negatively effects the project is during the customs clearance of equipment and material imported from other countries. In one of our project

one critical piece of equipment was held in customs for over forty days even though all the necessary documents were provided to the officials on the very first day.

3. Unforeseen Circumstances

Due to unstable political environment in some of these countries there might arise certain circumstances which have very detrimental effects on the execution of projects. Not just the countries where the project is based but also the political environment in neighboring countries can have impact on the project. The recent military coup in Burkina Faso led to a two week delay in one of our horizontal construction project in Niger, even though the project was not based in Burkina Faso. The material delivery through Togo was supposed to come through Burkina Faso but due to the military the delivery had to be rerouted through Benin at the last stage which ended up taking two more weeks for delivery of material at site. In one of the other projects in Kenya the mobilization date had to be moved because of a threat issued by a terrorist organization [14].

4. Environmental & Social Concerns

Most of these countries do not have strict environmental regulations and based on my experience and interaction with subcontractors in East and West African countries, the attitude of people is pretty cavalier about issues like waste generation & disposal, deforestation etc. To introduce the concept and enforcing it becomes a very difficult task. No one wants to take the responsibility of safeguarding the surrounding environment and minimizing the impact of construction activity on the lives of surrounding population, the subcontractors and contractors do not want to spend their efforts on these issues. They don't see any value in it and not doing these things will not affect them in any direct way. To implement a stern environment policy becomes the responsibility of the contractor and implementing it from an offsite location is not possible. The contractor has to put it in the contract to have an HSE officer always present on site, then he has to modify and create new environmental compliance policy for all the different projects to be followed by the subcontractors and above all frequent surprise visits to site are required to get these policies properly implemented.

One other responsibility of the construction contractor is to ensure that lives of people living the vicinity of the construction site are not negatively impacted. Again, due to loose governance system there are very few laws or regulatory requirements to keep contractors in check by setting restrictions on various construction led nuisance like noise, construction waste generation and dumping, interference with traffic, etc., monitoring the activity on site and its impact on the lives of surrounding population and penalizing the contractor for any undesirable ramifications on the lives of surrounding population. As a result access roads are blocked with piles of sand and aggregates, noisy construction work is done till late in night, construction waste is dumped on the sides of road and waste water is not properly disposed and puddles of water become breeding grounds for mosquitos. To prevent all these, in our projects, we undertook the responsibility of educating the subcontractors about these issues and the importance of preventing them and in my opinion every contractor working in underdeveloped regions should assume this responsibility.

Consequences of Issues

The three major consequences of the issues discussed above are as following.

1. Overbidding on projects

For bidding on projects in these countries we have to rely on a lot of second hand data, (data not obtained directly from the primary sources but from sources which are in contact with the primary sources). As it is very hard to contact the material vendors, you cannot ascertain the prices and availability of materials. You have to rely on subcontractor's word while pricing out these projects. The other problem arises because of lack of site data, as there is very little to no data available (e.g., water table, bedrock depth or bearing capacity), a lot of contingency has to be included in the bid to price out these projects. As discussed initially, due to lack of development in the area, there is limited information available to the locals about new methods of construction and while estimating the productivity of labor we again tend to use a lot of contingency because of the lack of a clear picture.

2. Increase in Safety and Quality related incidents

As discussed above due to the disregard for safety and quality control procedures, inexperienced personnel on site and use of primitive methods for construction the performance of construction projects in these countries on safety and quality scales is very bad. Accidents on construction sites are very common, most of these accidents don't even get reported to the proper authorities because of lack of proper administration and reporting mechanisms. Sites do not maintain risk registers or accident log. Safety and quality audits are almost nonexistent.

3. Schedule & Cost Overruns:

As per [15] , there are types of causes for cost and schedule overruns:

- I. Those over which neither contractor nor owner has any control.

- II. Those over which owner has control.
- III. Those over which Construction contractor has control.

For my study I am most interested in the delays which are under the construction contractor's control.

The following table is taken from [16]. The table lists the relative significance of delay causes.

THE INDICES OF VARIABLES AFFECTING TIME AND/OR COST CONTROL	
	Index
Variables of delays and cost control	
Environment Restrictions	0.37
Experience of Project Location	0.35
Accurate Prediction of equipment production rate	0.33
Equipment Availability	0.33
Experience of Local Regulation	0.25
Weather Conditions	0.24
Variables of time control	
Buildability	0.91
Labor Productivity	0.65
Level of Planning	0.55
Material Availability	0.52
Accuracy of materials estimate	0.51
Accurate prediction of craftsmen production rate	0.49
Skilled Labor Availability	0.43
Local restriction of the project	0.40
Variables of cost control	
Inflation of material cost	0.54
Accurate quantity take-off	0.49
Experience of project type	0.31

Table 3: The indices of variables influencing time, and/or cost control

Source: "Factors influencing construction time and cost overruns on high-rise projects in Indonesia" [16]

Most of the causes listed in the table with high index value are under the scope of contractor.

- a) Buildability, which has the highest index value, is affected by many things like resource availability, time constraints, safety requirements, etc. To prevent issues related buildability, data on site characteristics, understanding of safety requirements, and data on material availability are required before the start of design phase. It is the prime cause of rework.
- b) Labor Productivity: As discussed earlier labor productivity is affected a lot of different factors, e. g., site conditions, work hours, resource availability, equipment efficiency, most of which are under contractor's control.
- c) Material Availability: Material availability is closely tied to proper planning, both of which most of these projects lack.
- d) Accurate Quantity Takeoff: Because of the lack of experienced personnel with subcontractors, accurately estimating the quantities becomes a difficult task.

Due to all these factors cost and schedule overruns are very common in construction projects in these countries. The following two graphics are taken from [17]

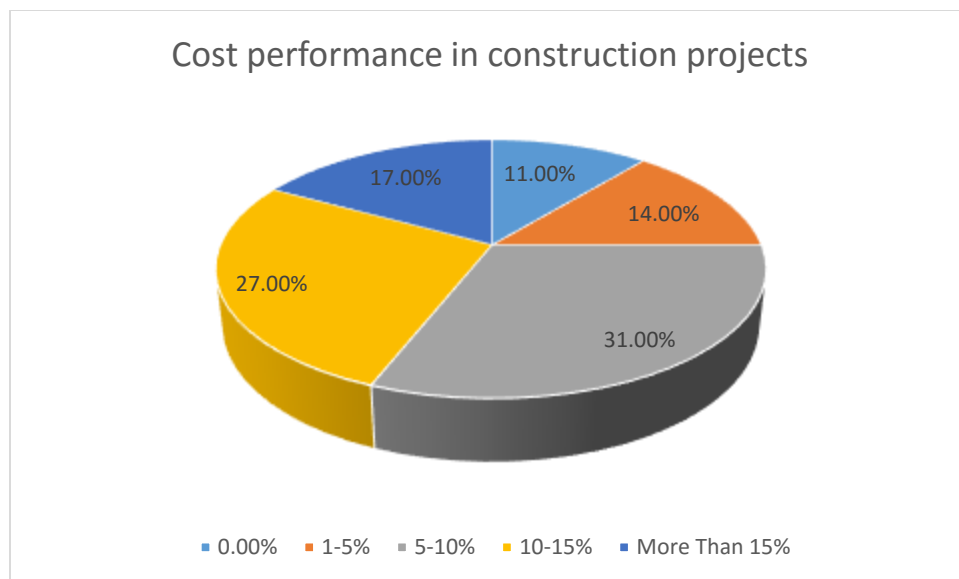


Figure 4: Cost Performance of Construction Projects in Southern and Central Regions of Peninsular Malaysia

Source: "Time and Cost Performance in Construction Projects in Southern and Central Regions of Peninsular Malaysia" [17]

The figure above shows that out of 140 projects studied only 11% had no cost overrun and approximately 44% had a cost overrun of more than 10%.

Time performance of construction Projects			
Percentage of Time Overrun	Frequency	Percent (%)	Cumulative Percent
0.00%	11	8	8
1-5%	20	14	22
5-10%	24	17	39
10-15%	48	34	74
More Than 15%	37	26	100
Total	140		

Table 4: Time Performance of Construction Projects in Southern and Central Regions of Peninsular Malaysia

Source: "Time and Cost Performance in Construction Projects in Southern and Central Regions of Peninsular Malaysia" [17]

The table above shows that out of 140 projects only eight finished on time and approximately 61 % projects had a schedule overrun of more than 10 %.

Case Study

In this case study I am discussing the problems we faced while submitting a proposal for a construction project in Africa in 2015. The project required construction of multiple hard wall accommodation and office units. The project sites were located in different regions of Somalia. The project was planned to be executed with the help of multiple local subcontractors and they were invited to submit their proposal for execution of works.

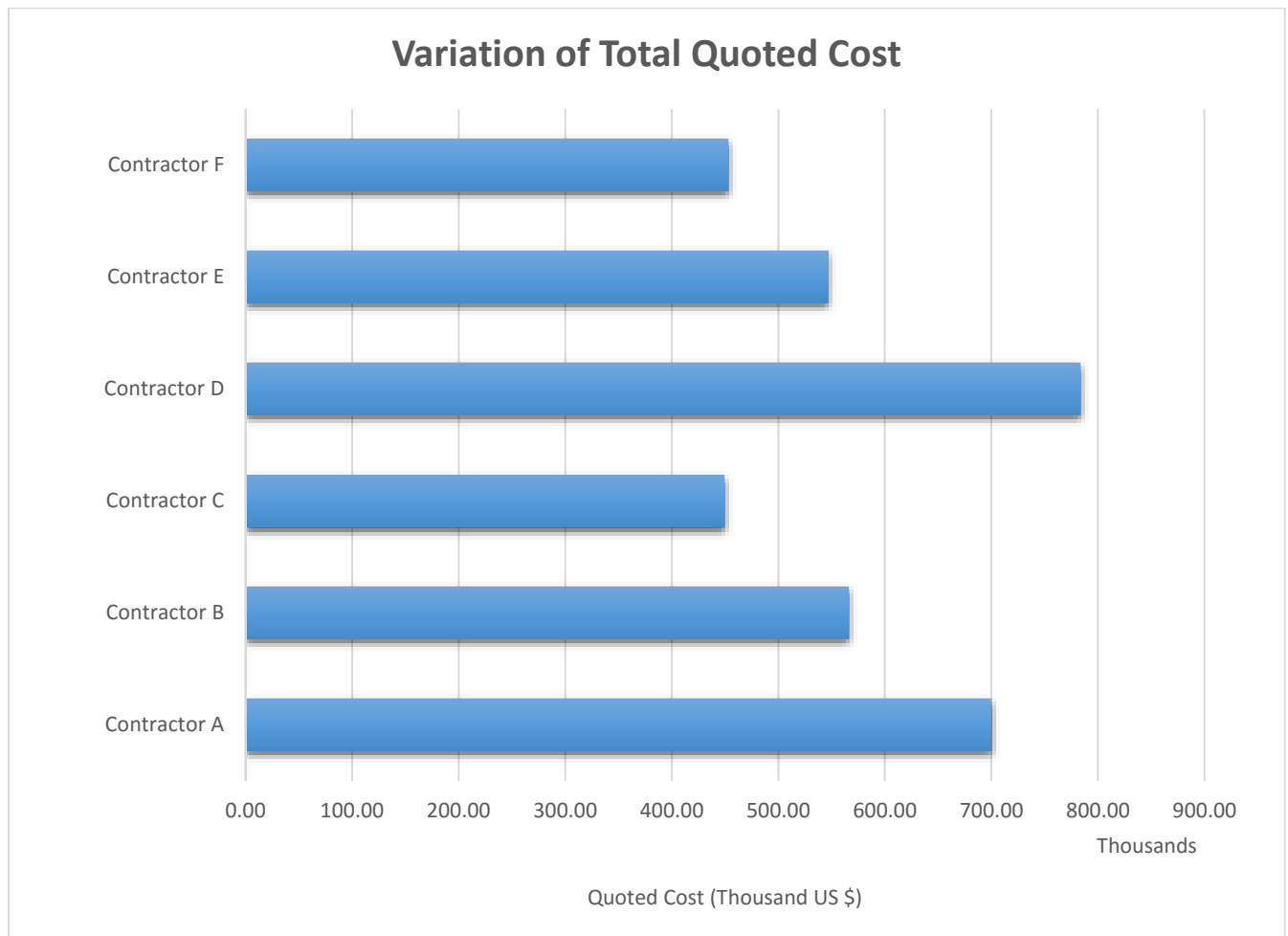


Figure 5 : Variation in Quoted Costs

**Based on Company Data from Summer Internship*

The figure above, shows the quoted prices for same project by six different contractor. The highest bid was approximately 75% higher than the lowest bid. The other bids filled the range between lowest and the highest and there was no substantial evidence to suggest the validity of one bid or other. This made it very complex to put a final number on our bid.

To get a better understanding of prices between subcontractors we compared unit costs of different line items.

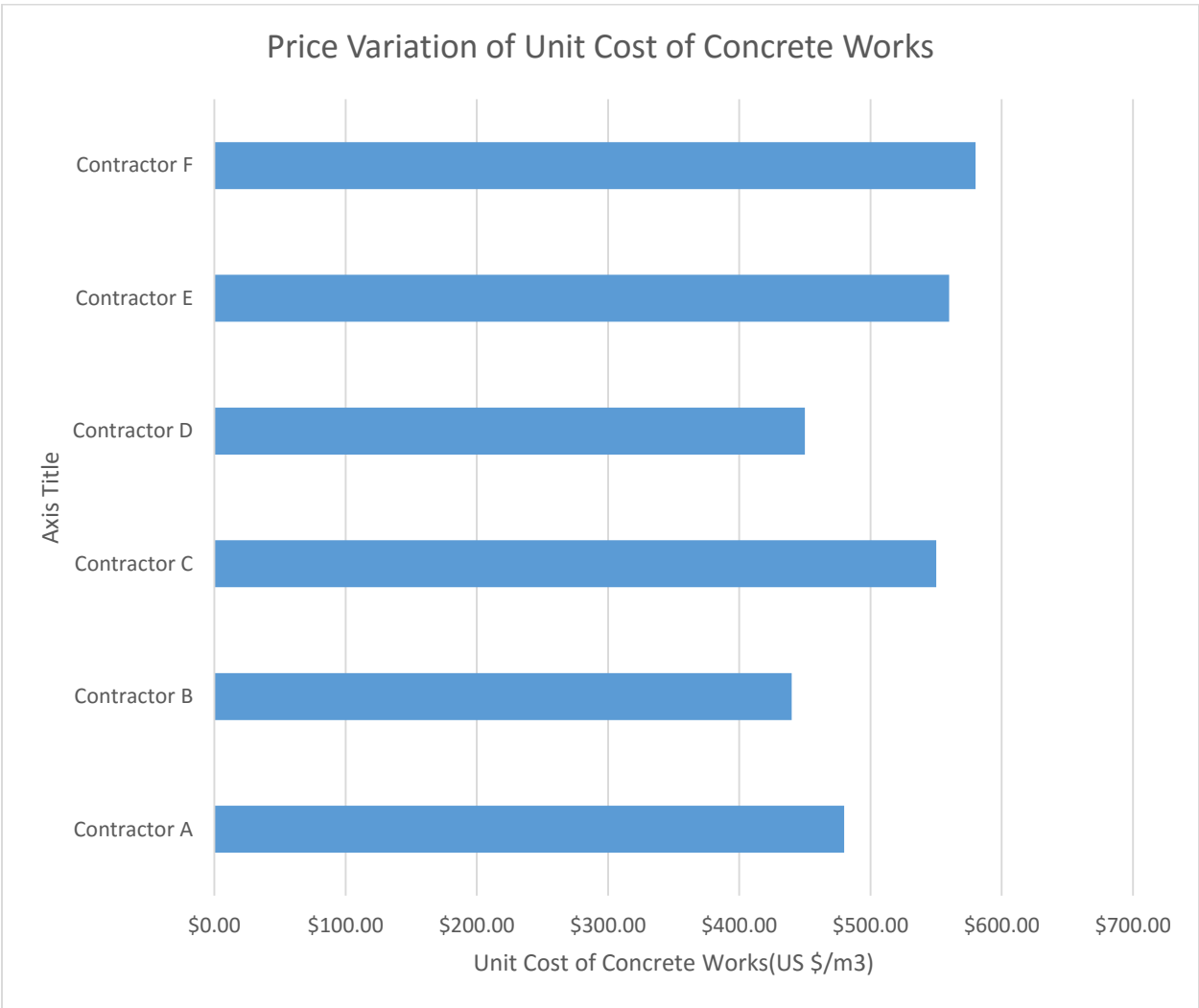


Figure 6: Price Variation in Unit Cost of Concrete Works

**Based on Company Data from Summer Internship*

The figure above, shows the bid prices for a cubic meter of concrete for different contractors. As we expected there was a variation in the unit cost but the interesting thing was that it was not in line with the variation in total quoted price. For example, Contractor C had the lowest total quoted price but its unit cost for concrete (which was a major cost item) was one of the highest, which meant that its unit prices for some of the other line items were significantly lower than other contractors. We tried to come up with a rational method to come up with a final quote by comparing these prices.

To further ascertain the validity of these unit prices our team started comparing them with the unit prices we received from the same contractor for different projects in those regions.

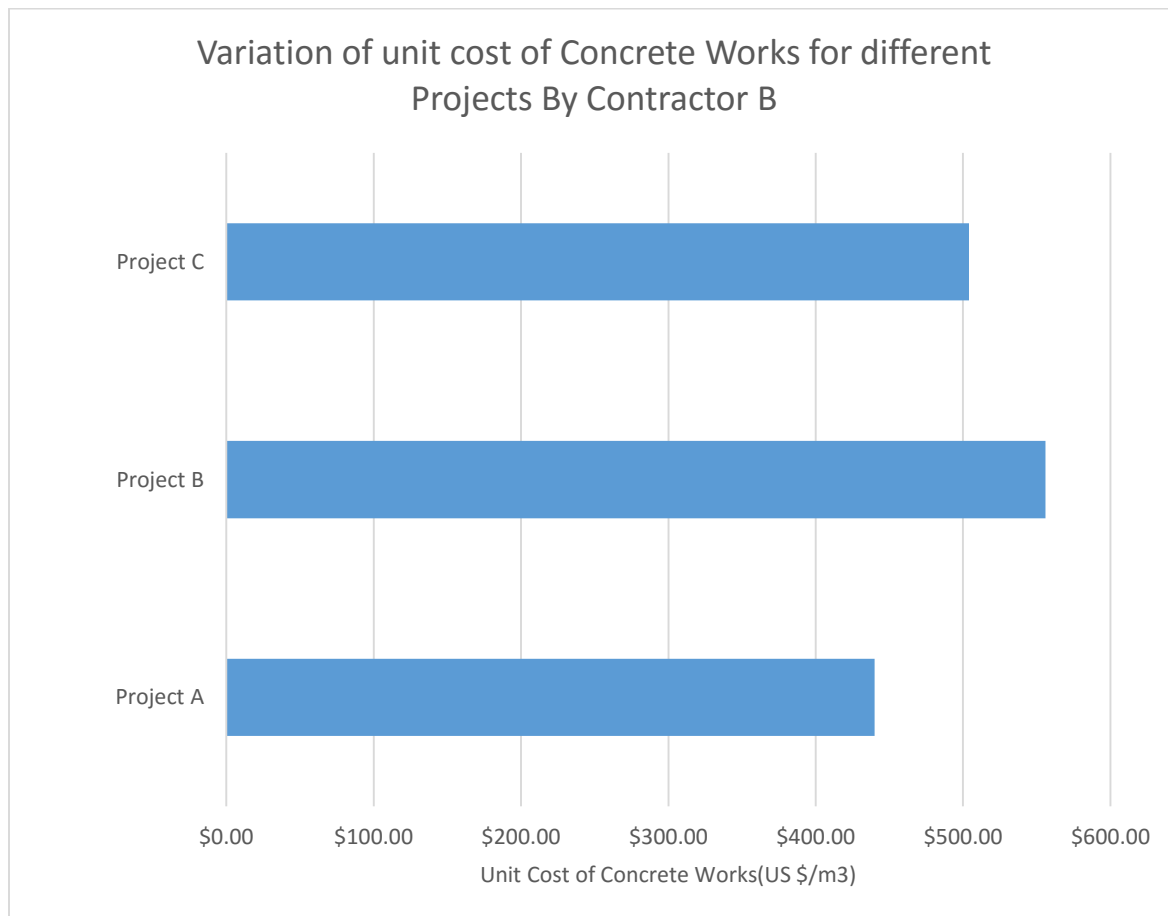


Figure 7 : Variation of unit cost of Concrete Works for different Projects By Contractor B

**Based on Company Data from Summer Internship*

The figure above shows the variation in unit prices of concrete provided by Contractor B, There was approximately 25 % variation in prices, which was somewhat reasonable and can be attributed to reasons like difference in the quantity required, price fluctuation over time (inflation/deflation), ease of mobilization and availability of manpower & equipment.

As the projects comprised of construction of multiple (> 100) identical residential units in several different locations, we were also required to provide our construction capability as the part of the proposal. For this purpose we asked the subcontractors to provide us with their best estimate for the duration of construction of a single two story residential unit as per the contract drawings.

The figure shown below shows the variation of estimated duration for the construction of single two story residential unit.

The spread for estimated duration was not as large as expected cost. Contractor B, had the lowest estimated duration and Contractor E had the highest quoted duration. The quoted price by both the contractors was very close but there was a 24 % variation in their estimated duration.

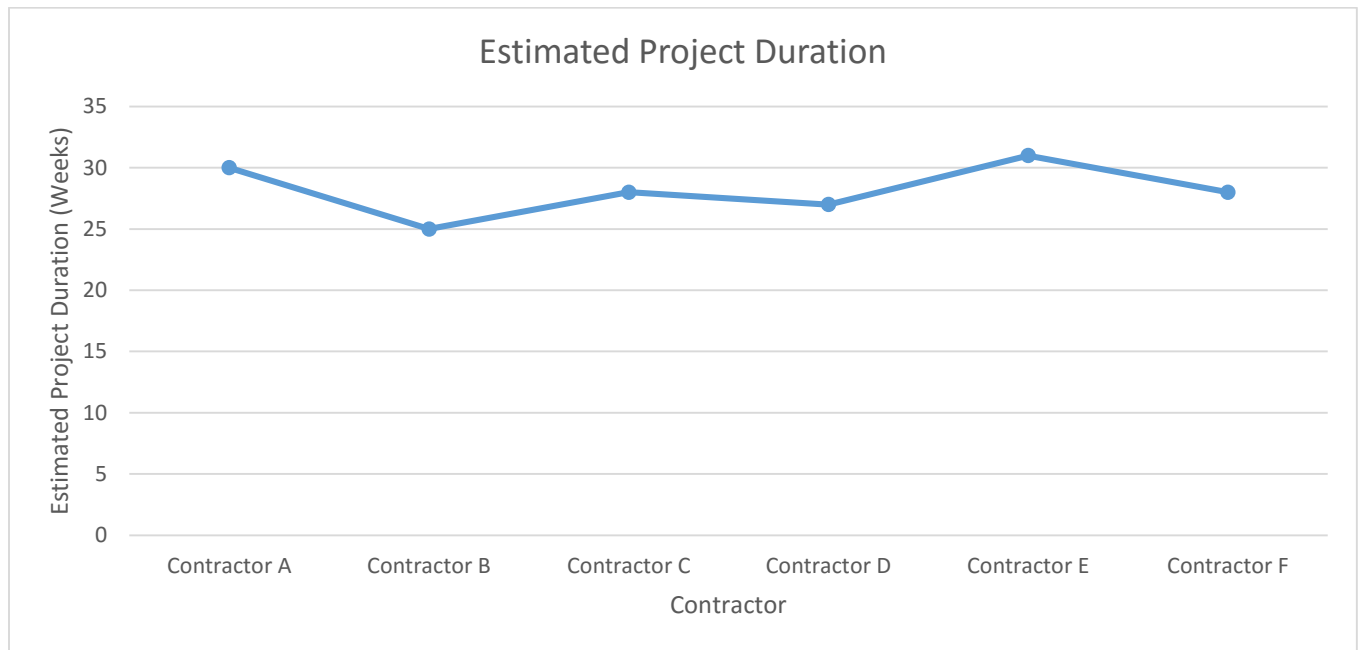


Figure 8 : Estimated Project Duration

**Based on Company Data from Summer Internship*

Duration and Cost generally have a direct relation if estimated properly.

But the cost of the project can also increase if we try to expedite the project. If that was the case Contractor D should have had the lowest estimated duration. This made us question the validity of prices even more.

[5] suggests that the construction duration for office buildings in UK is dependent on construction cost by the following equation:

$$\text{Construction Duration (Weeks)} = 22.603 * (\text{Log}_{10} (\text{Construction Cost})) - 96.944$$

Source: "Predicting Construction Duration of Building Projects" [5]

Based on this relation the expected duration was calculated based on the estimated Cost of project. The following figure shows the variation in estimated duration and expected duration based on estimated cost.

The study by Martin et al. (2006), was based on data from construction projects in England, so the results cannot be applied directly but the results are still good for comparison between the quoted prices and durations for same scope of work in the same location.

The second figure is also based on the results in [5]. It shows the comparison between estimated cost and the expected cost based on estimated duration. As the resource requirement provided by all the subcontractor's was almost similar and the work timings were fixed as 40 hours a week, the assumption of the direct correlation between project cost and duration was reasonable. So any the deviation in ratio of quoted price to duration might indicate poor understanding of the scope of work or inaccuracy in pricing or duration estimates.

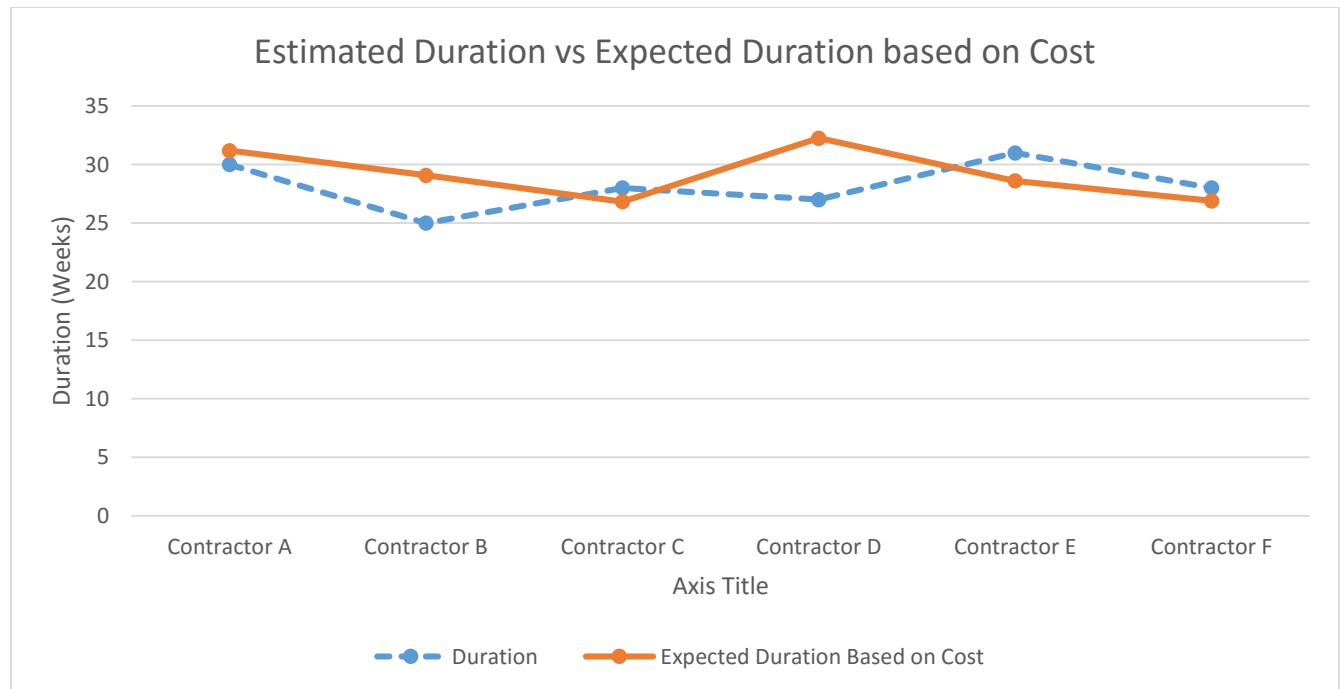


Figure 9 : Estimated Duration vs Expected Duration based on Cost

**Based on Company Data from Summer Internship [14]*

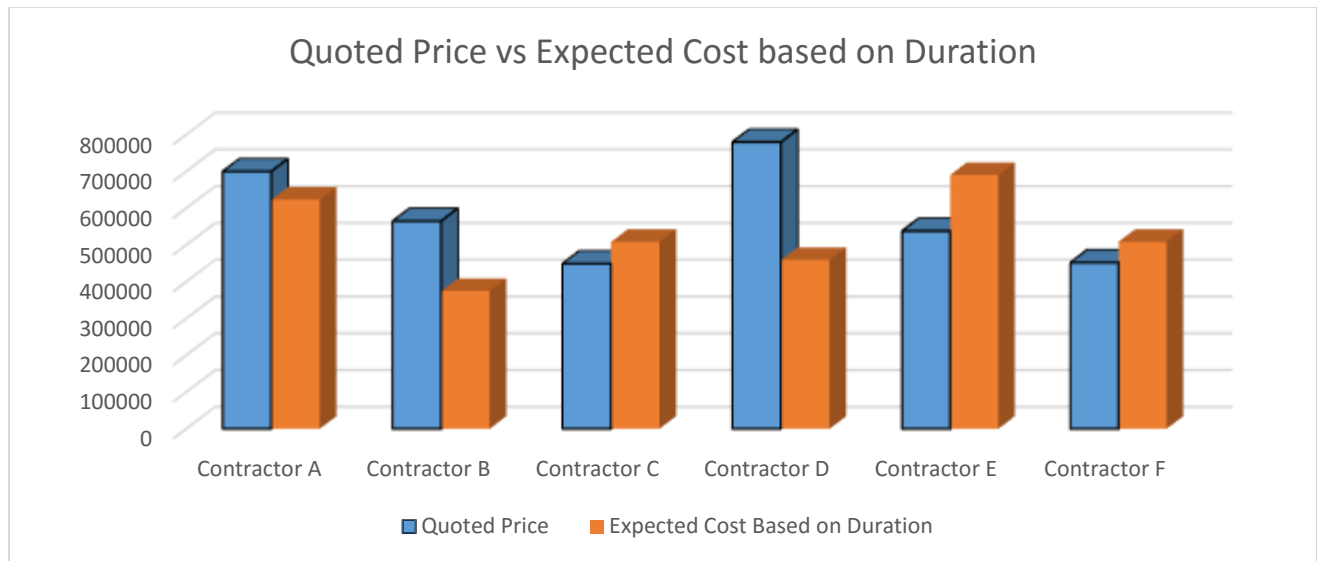


Figure 10 : Quoted Price vs Expected Cost based on Duration

**Based on Company Data from Summer Internship [14]*

Both the figures show that there is inconsistency in the expected cost and expected duration from around -30% to 20%. This variation points out the ambiguity in quoted price and duration and supported our decision to gather more information on local material and labor prices and availability.

After doing all these analysis, we decided to contact the material vendors to validate the cost of different line items. It was not very easy to contact these vendors as none of them had any websites or readily available contact information. All we had was their name and the city they were located. To get in touch with them we established a local point of contact in Mogadishu, using references from our project personnel from our ongoing project in the neighboring country Kenya, and had him go out and gather all the relevant information like prices and availability of material, labor availability, validation of subcontractor's claimed work and inventory of material, etc. for us.

The project required construction of multiple similar units and although it was a lump sum contract the owner wanted us to provide an estimate of capacity in terms of the number of units that can be completed in one calendar year. This owner reserved right for a split award and the number of units that were to be awarded to a contractor would be

dependent on his capacity. So, the following were the major points that were considered to arrive at a final number for the capacity:

- I. **Financial Capability:** The contract required a 10% performance guarantee from the contractor. A greater capacity implied a greater amount for performance guarantee. Although the subcontractors were required to provide 10% amount on their subcontract amount, as we had to provide the performance guarantee for all the subcontractors it was a significant amount and hence a huge driver in final decision making.
- II. **Capability of Subcontractors:** Most of the subcontractors claimed having enough resources to work on three units simultaneously. This capability of working on multiple units simultaneously varied from 3 units to 7 units for different subcontractors. But none of them were able to provide any substantial proof to validate their claims. Due to the recent sociopolitical scenario of Somalia, there has not been any major infrastructure work performed. So it was very hard to believe what the subcontractors were claiming. The other major concern was the financial capabilities of the subcontractors. As they also had to come up with significant amount financial guarantee based on the number of buildings, based on the economic environment of the country it was hard to believe that they could get financial backing for the amounts they were committing to.
- III. **Actual Duration of Construction:** As discussed earlier, due to the variation in the time quoted by each contractor for the construction of a single unit and irregularities with pricing and durations, we did not have a clear idea of the duration for the construction of a single unit. Without this information, it was very hard to project the capacity for entire year.
- IV. **Volatility of the sociopolitical environment:** Due to the unstable sociopolitical environment in the country, it was very hard to identify a reasonable cost number

for a lump sum job. Although, in any such situation we would not have been penalized as it would have come under the Force Majeure Clause, which protected us from any damages due to circumstances which could not have been predicted and were out of our control, but the money committed as performance guarantee would get stuck and become a huge burden.

The final cost was based on all the information we received from subcontractors & vendors and the amount of risk which we assessed based on different contributing factors. The risk assessment was based on following factors:

- Subcontractor's experience
- Subcontractor's past performance on similar projects
- Subcontractor's past performance in the region
- Subcontractor's workforce and equipment list
- Quoted price and duration
- Location of the project

Conclusions

Even with the best management skills and knowledge there are lot of circumstances like weather related obstructions, third party shipping delays, force majeure, etc. which are very hard to control. The probability of occurrence of those negative circumstances is elevated by the certain issues which are predominant in the third world countries. With good management skills, proper planning and doing the due diligence we might be able to reduce the probability of occurrence of those negative circumstances but to have considerable control over construction projects in these countries a systematic change is required. Until that systematic change comes it is very hard to achieve any significant improvement in the performance of construction projects.

Recommendations

Following measures can help reduce the risk involved with these projects:

1. Comprehensive Pre project Planning

Construction projects will always have a certain element of uncertainty which makes them extremely risky. In my opinion, there are two ways to deal with risk, first is risk aversion and the other is risk mitigation. Risk aversion requires preparing a concrete plan to reduce the uncertainty in projects and risk management requires preparing a contingency plan in case anything does not go as per plan. Both of these require cogent pre project planning. As per [18], there exists a positive co-relation between the pre-project planning effort and the success variables like schedule and cost performance for Capital Facility Projects.

2. Clear understanding of the scope and project goals

It is crucial to develop clear understanding of project requirements, the execution of construction tasks in underdeveloped regions is very hard and most of the times deviation from scope will lead to rework which will require extra effort on the part of contractor. It is the duty of contractor personnel to stay within the bounds of contract requirements and request for a deviation request or a change order whenever necessary. In [19] the author asserts that it is of very high importance that the project team clearly understand

scope of project requirements which is achieved by involvement of end user in project planning from an early stage. The understanding of project goals directly depends on the project definition which can be evaluated using CII's scope definition tool, Project Definition Rating Index (PDRI) [20] [21]. The findings of [22] indicate that is a direct correlation between PDRI score and schedule/cost growth for the sample projects considered in the study.

3. Smart Risk Management

Construction projects in third world countries involve a lot of uncertainty and hence the risk associated with these projects is also very high. Contractors while working in these regions tend to subcontract the entire work to one subcontractor which puts the entire burden on that one subcontractor, instead of this risk being shared by different parties is a more efficient way of managing risk. As per the author in [23], risk should be transferred to the party that is in the best position to deal with it. The first step in risk management is risk identification, instruments like Construction Industry Institute's International Project Risk Assessment tool (IPRA) [24] can be used to identify various risks and assess their impact on a particular project. IPRA provides a comprehensive risk assessment, it classifies project related risk into 4 main categories, which are divided into 14 subcategories, which have a total of 82 risk elements. IPRA also provides a measure for relative importance for a given risk element, which is dependent on the relative impact of the risk and its likelihood of occurrence.

4. Contingency Planning

Contingency planning requires planning for any unprecedented scenario which can have a negative impact on project execution. It is always advisable to develop alternative plans for all the critical procurement, logistics and construction activities. One other thing required is to study the time-cost tradeoff for critical and near critical project activities and setting aside reasonable resources for bringing project back on track in case of any schedule or budget creep.

5. Modularization

Due to lack of site resources, site conditions and multiple other factors the quality and efficiency of works is generally sub-par. Modularization can help a great deal in improving the quality of works and reducing the timeline of the projects as most of the work will be performed by professionals in controlled environment. It will also lead to lesser time being spent on site by construction personnel which will lead to better safety performance and in some cases significant reduction in construction costs. Overall, modularization leads to improvement in both quality and productivity of works [25].

6. Systematic Project Monitoring

As discussed above, project progress monitoring and evaluation is very challenging task in these regions. To better monitor the progress, a progress monitoring plan should be developed and site personnel should adhere to the plan. To improve the authenticity of the data received from site, time and location stamps should be included in the pictures from site. Site progress reporting services which do not require advanced internet infrastructure and ensure a steady flow of information from site should be used for this task. Also, to reduce chances of misreporting, simple systems should be developed so that the accuracy of the progress reporting does not depend on the subjective interpretation of site personnel [26].

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